TDTS 58

The application of thermal desorption to forensic investigations

Summary

This Application Note introduces the use of thermal desorption (TD) in the detection of chemicals in scene-of-crime samples, including arson debris, firearm propellant and house dust.

Introduction

The detection and identification of VOCs is an important aspect of forensic science, and thermal desorption has historically been used extensively for analysis of arson debris to determine the nature of the accelerant used. The applicability of TD, however, is not limited to this specific application, and there are a number of areas where TD may be a useful tool for the forensic scientist.

The range of applications in which TD can be employed includes characterisation/detection of firearm propellant, detection of proscribed drugs, and explosives detection. A further application, becoming of increased interest in civilian as well as military areas, is the ability to detect and identify chemical warfare agents. This is a result of increased concern for homeland security and public health & safety. Three examples of these applications are provided below

Characterisation of accelerants in arson debris

In suspected arson cases, it is often necessary to establish the nature of the accelerant used to start the fire. It is common practice, amongst scene-of-crime officers, that samples of the arson debris are collected for analysis. Generally, the debris is sealed within a nylon bag, before gently heating the bag to aid the release of VOCs into the headspace of the debris. Typically, a small hole is made in the bag and a known volume of the headspace sampled onto a standard TD tube packed with Tenax® TA, using a gas syringe. The profile of the arson debris headspace is indicative of the accelerant used to initiate the fire (Figure 1).

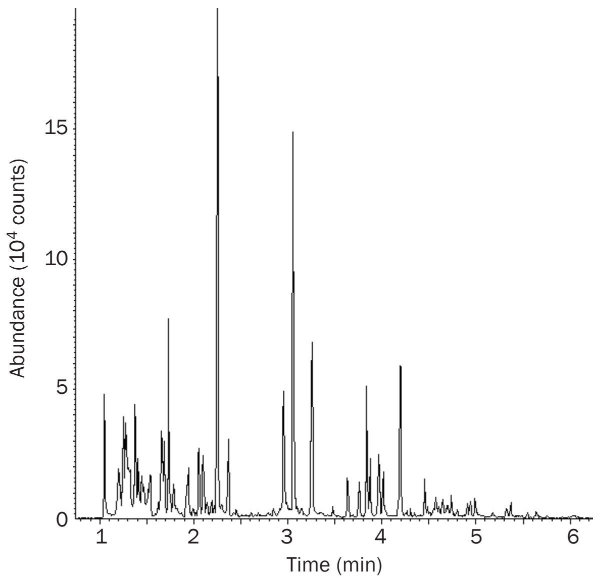

Figure 1: Sample of headspace from cloth soaked in petrol, transferred using a gas syringe onto a stainless steel TD tube packed with Tenax TA.

Detection of explosives

The detection and identification of explosives by thermal desorption is an application encountered in both military and forensic areas of investigation. The sample can vary from an air sample taken from a tanker suspected of carrying explosive to small particles of firearm propellant. Due to the nature of the sample, the trap used to focus the sample prior to GC injection requires careful selection to ensure that the components of interest do not break down during the analytical process. The high-boiling, labile nature of the explosive compounds necessitates the use of an inert tube (inert-coated stainless steel or glass) with quartz wool sorbent. The inertness of the flow path in Markes' UNITY™ TD systems is demonstrated by its ability to successfully analyse explosive compounds such as DNT, TNT and RDX (Figure 2).

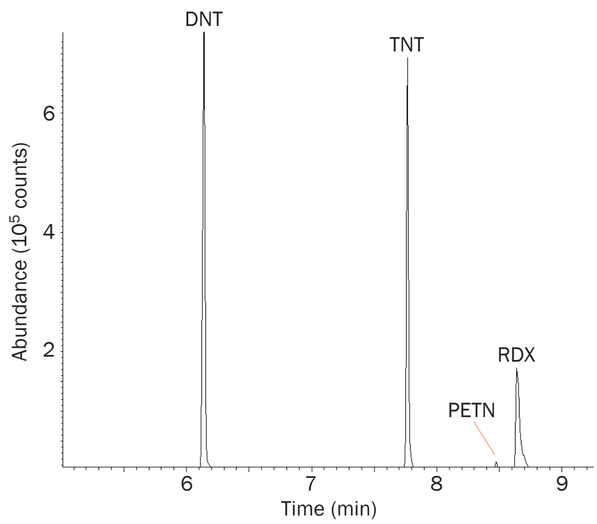

Figure 2: Detection of explosives illustrates the inertness of the UNITY flow path.

The composition of small particles suspected to be firearm propellant can be analysed by gentle direct desorption inside an inert-coated stainless steel TD tube. This releases the components of interest, free from extensive interference due to the sample matrix (Figure 3).

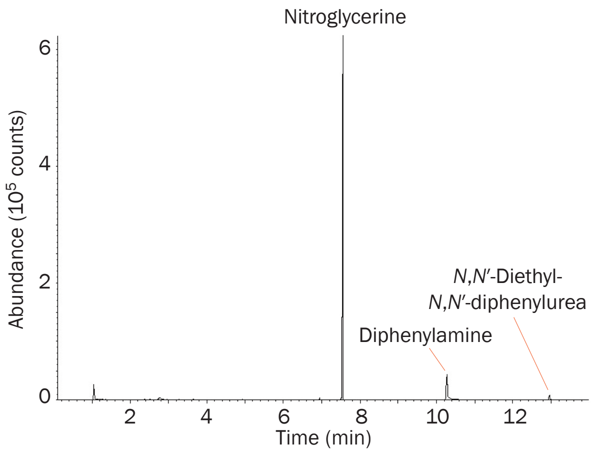

Figure 3: Direct desorption of fine particles of firearm propellant.

Detection of drugs in house dust

By gentle direct desorption of samples suspected to contain traces of proscribed (banned) substances, it is possible to confirm the presence of chemicals such as heroin and cocaine with minimal sample preparation (or interference from the sample matrix itself).

As an example of this, a small amount of dust, from a house suspected to have been involved in drug use, was placed into a glass TD tube, along with a plug of glass wool. Desorption was carried out at relatively low temperatures, to mimimise breakdown of the compounds of interest (Figure 4). This technique is therefore suitable for identification/confirmation (rather than absolute quantitation) of the drugs. The high-boiling nature of these drugs required careful selection of the focusing (cold) trap – in this case, the 'Chemical weapons' trap provided the optimum inertness and trapping/desorption capability.

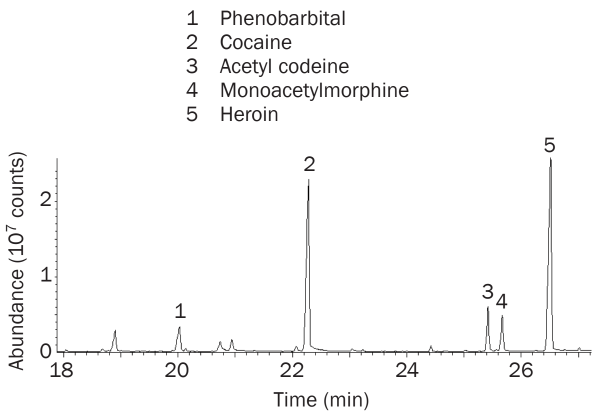

Figure 4: Direct desorption of house dust, indicating the presence of proscribed drugs.

SecureTD-Q as a tool for the forensic scientist

Markes' unique SecureTD-Q™ capability, an integral feature of all UNITY and ULTRA™ TD systems, allows quantitative re-collection of sample for repeat analysis and method validation. This feature is a valuable asset to the forensic scientist, who may need to re-collect samples for archiving and/or third-party confirmation. Previously, this was not possible due do the 'one-shot' nature of thermal desorption.

SecureTD-Q can also be used in method development and validation, as a confirmation of desorption efficiency and quantitative recovery of sample through the analytical system. Any bias within the system can be determined if a sample is recollected, then re-analysed under identical conditions. The re-collected sample should correlate with the initial sample. Examples of the use of SecureTD-Q can be found in Application Note TDTS 24.

Trademarks

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